Smart4RES

Data Science & the future of RES forecasting

energy & meteo systems · DLR · ETHZ IGGS · DTU MINES PARIS · PSL · ARMINES

Research challenges

RES forecasting solutions are vulnerable to real-world information limitations, such as lack of available data. To improve RES forecast in the time horizon between seconds and 30 minutes, different data-science based approaches had to be developed combining data collected from different sources and in different temporal domains.

Main outcomes

Eight different optimisation solutions to blend information from multiple sources have independently been developed and tested. Used in combination with RES forecasting models, these approaches support informed-decisions even when information is scarce, resulting in higher resolution and accuracy of RES forecasting.

By exploring multi-source data, including satellite images, all sky images, Lidar remote sensing data, lightning data, SCADA and power data from wind farms as well as data from numerical weather prediction models, we are able to improve power forecasts across multiple time horizons. Most of these approaches integrate new sources of data, that have not been used in the context of RES forecasting before, into existing RES forecasting models.

Toolbox of multi-source data approaches

The use of **combined Satellite and AllSkyImager (ASI) Irradiance Forecast** for PV power forecasting shows a significant improvement of up to 18% when compared to using only the ASI forecast.

Using **Skyimager data** allows to improve the minute ahead PV power forecasting **performance of up to 23%.**

By using **lightning maps**, short-term solar prediction are improved by 14% in critical situations such as thunderstorms.

Advanced outlier data filtering and machine learning techniques improve power curve by up to 8% compared to operational EMSYS forecast

4-beams Lidar features and structural loads enable to increase second-ahead forecasting performance of wind active power (2-4s).
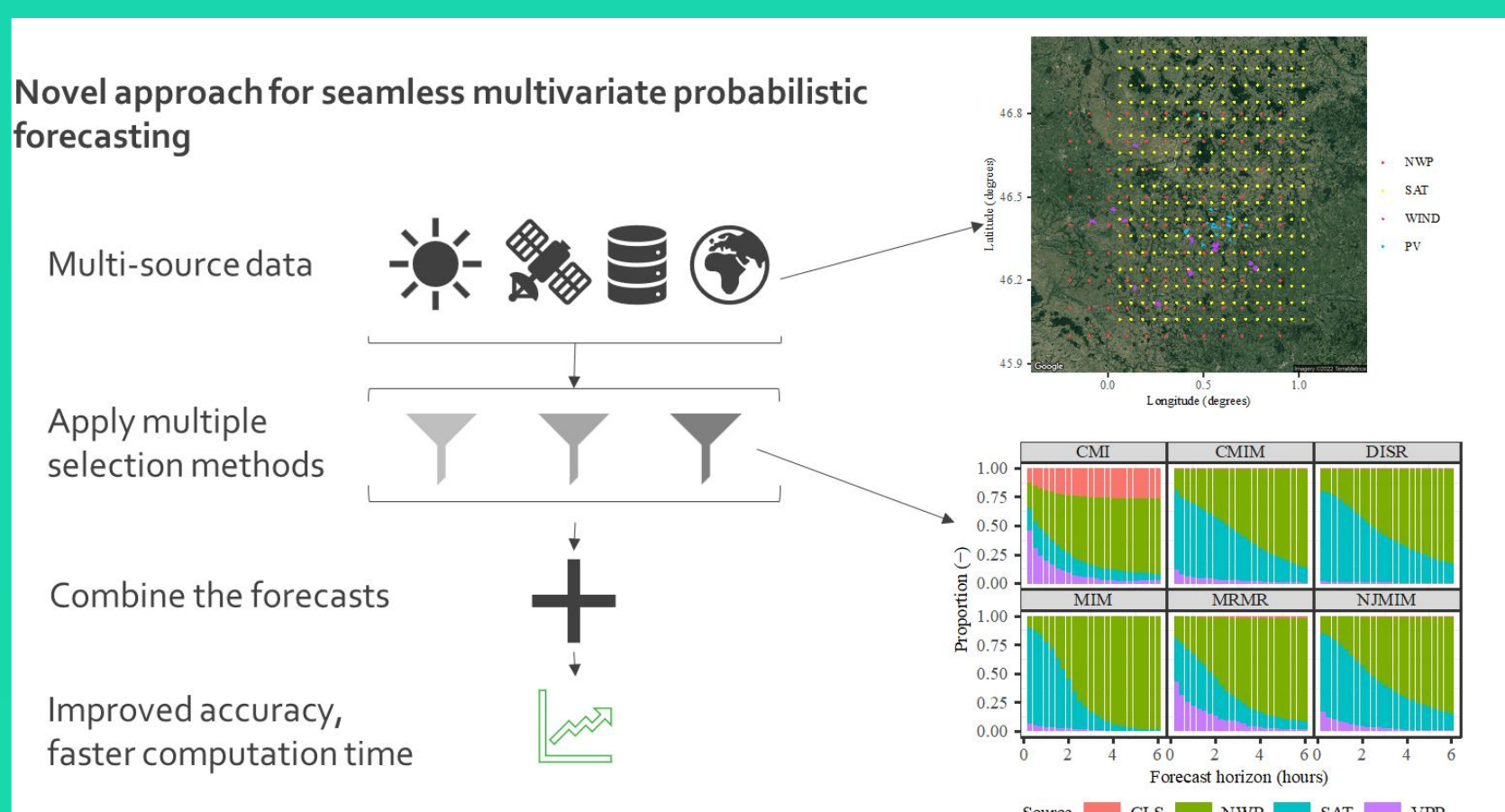
Investigating the capabilities of **AI-based dynamic forecasting approaches and additional SCADA** data channels shows up to 46% RMSE improvement of dynamic Gated Recurrent Unit (GRU) networks compared to single GRU networks and persistence

Applying **AI techniques and blending satellite irradiance maps** with NWP data allow to improve day-ahead and hour-ahead PV forecasting (5-17%)

Filter-based seamless renewable forecasting

Novel approach for seamless multivariate probabilistic forecasting

Multi-source data

Apply multiple selection methods

Combine the forecasts

Improved accuracy, faster computation time

✓ Multivariate probabilistic forecasting **reduces computation time by ~99%.**

✓ **Seamless RES forecasting model with enhanced feature** selection mitigates uncertainty and improves calibration, thus **improving RES forecast accuracy by 16-31%.**

Download WP3 deliverables

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